7.2.2 Protection Zones for Out-of-Band MSS Uplink Transmissions

In addition, IWG2 proposes fixed protection zones for MSS uplinks in the bands immediately adjacent to the 1610.6-1613.8 MHz band. However, these protection zones would be substantially smaller than the protection zones necessary for co-frequency operation.

7.2.3 Impact of Sharing with Radio Astronomy

The recommended sharing solution with Radio Astronomy would preclude MSS service in the 1610.6-1613.8 MHz band within the protection zones with as much as 100 mile radius during periods of observation. MSS service in immediately adjacent frequencies would be subject to significantly smaller protection zones.

MSS transmitters operating in these portions of the band will be forced to operate in higher frequencies when within a radio astronomy site protection zone during periods of observation. This will reduce the available spectrum near the sites by about 23% (3.8/16.5) under any band sharing approach. If less than 16.5 MHz is available the overall number of channels available would be further reduced for the systems operating on an interference sharing basis.

IWG1 encourages further work on implementation of the beacon concept to increase the spectrum sharing efficiency of the MSS systems.

7.3 Sharing with Aeronautical Radionavigation

The Global Positioning Service (GPS) and GLONASS systems operate under the radionavigation-satellite (space-to-Earth) service allocation in the 1559-1610 MHz band. The band 1610-1626.5 MHz is also allocated to the Aeronautical Radionavigation Service on a primary basis. RR 732 indicates that the 1610-1626 MHz band is also reserved for the use and deployment of airborne electronic aids including satellite-borne facilities subject to agreement under the procedure set forth in Article 14.

IWG2 recommends that the Commission adopt the uplink EIRP density limit in RR 731E of -15dBW/4kHz. The aviation community believes that this limit would not sufficiently protect GLONASS, and interprets the clause in RR 731E, which provides that MSS stations "shall not cause harmful interference to" the aeronautical radionavigation service, to require greater protection.

The aviation community has proposed a mobile earth station (MES) EIRP density level of -78 dBW per 1 MHz for co-frequency operation over spacings of 100 meters between an MES and a GLONASS receiver operating in the 1610-1616 MHz band. Based on the current technology used in GLONASS receivers, MSS systems cannot meet this proposed limit for co-frequency operation.

If the Commission were to accept the aviation community's stated requirements for use of GLONASS as a component of a "sole means" Global Navigation Satellite Service (GNSS), the co-primary MSS allocation in the 1610-1616 MHz band would be effectively unusable because of the disparity between the aviation community's protection requirements proposed to IWG2 and practical EIRP levels needed to support MSS uplinks.

Mobile units which operate with mobile-satellite systems utilizing any portion of the 1610-1626.5 MHz band shall limit their out-of-band emissions so as not to exceed an e.i.r.p. density of -70 dBW/1MHz averaged over any 20 ms period in any portion of the 1575.42 +/- 1.023 MHz band for broadband noise emission. For any discrete spurious emissions in the same band, i.e., bandwidth less than 600 Hz, the e.i.r.p. shall not exceed -80 dBW. IWG-2 was not able to reach a consensus on out-of-band emission limits to protect GLONASS. Such out-of-band limits will be considered following a determination of whether the GLONASS frequency plan can be revised or reconfigured. The aviation community is in agreement that the same MES out-of-band emission limits of -70 dBW/1MHz broadband and -80 dBW narrowband (i.e., bandwidth less than 600 Hz) should also apply to any portion of the GLONASS operation band below 1610 MHz.

7.3.1 Principal Sharing Proposal For MSS And GLONASS

The principal sharing proposal by IWG2 is to reconfigure the GLONASS frequency plan to avoid co-frequency operation. The current GLONASS plan is to use 24 discrete carrier frequencies (one for each of the 24 satellites) in the 1602.5626 to 1615.5 MHz band. IWG2 proposes that the 24 operational satellites operate on only 12 carrier frequencies by assigning antipodal GLONASS satellites to the same carrier frequencies. No GLONASS performance degradation would result from this reconfiguration. Even allowing 14 carrier frequencies would permit GLONASS to operate below 1610 MHz, in the 1602.5625 to 1609.775 MHz band.

7.3.2 Impact of MSS Sharing with GLONASS

The sharing solution proposed by IWG2 would permit MSS operators to access the 1610-1616 MHz band. The proposed frequency reconfiguration plan would have to be accepted and implemented by the Russian administration. However, given the anticipated launch dates for the MSS systems, there is considerable time to explore this, and possibly other, sharing scenarios. If a sharing solution is not found, then it may not be possible for co-frequency operation to provide the level of protection to GLONASS that the aviation community has proposed to IWG2.

For reasons cited above, if the 1610-1616 MHz band cannot be used for MSS uplinks, the available uplink spectrum will be reduced by about 36% (6/16.5) under any band sharing approach. IWG2 has made no recommendation concerning out-of-band emissions to protect GLONASS. IWG1 believes that stringent out-of-band emission requirements may further reduce the available spectrum by requiring large guardbands.

7.4 Sharing with Services Other than Radio Astronomy and Aeronautical Radionavigation

IWG2 concluded that systems in the L-band other than in the RAS and Aeronautical Radionavigation services are sparse and will not pose a sharing problem. However, there are systems and applications in the S-band that need to be considered in assessing the impact on MSS downlinks.

7.4.1 MMDS/ITFS

The Multichannel Multipoint Distribution Service/Instructional Fixed Service (MMDS/ITFS) use twenty-eight 6-MHz channels in the 2500-2686 MHz band, adjacent to the MSS S-band allocation. IWG2 reports that there are about 500 MMDS/ITFS stations in the U.S., usually in urban and suburban areas. At one kilometer from the transmitter, MMDS yields a PFD of -72 dBW/m^2/4kHz in-band, which is 70 dB higher than the maximum signal from any of the MSS downlinks in the neighboring MSS downlink band. The current MMDS/ITFS out-of-band emission level is -60 dB relative to carrier. At this level, MSS would experience serious interference within several kilometers of an MMDS/ITFS station. IWG2 recommends that the Commission restrict MMDS/ITFS out-of-band emissions from the lowest channel (in the 2500-2506 MHz band) to -90 dB relative to carrier. According to the IWG2 report, even this requirement would leave a zone of something less than 1.0 km around an ITFS transmitter in which a mobile terminal in the MSS will be interfered with seriously. IWG1 believes that MSS operators may have to selectively assign downlink channels to avoid any potential interference from MMDS/ITFS transmitters.

7.4.2 Industrial, Scientific and Medical Applications

The 2400-2500 MHz band is allocated to Industrial, Scientific and Medical (ISM) applications. The most prevalent use of this band is for microwave ovens. IWG2 reports that the estimated population of microwave ovens is 80 million in the United States and 200 million worldwide.

IWG2's analysis indicates that there may be an ISM interference noise floor in populated areas. MSS users in populated areas, may experience levels of cumulative interference exceeding the thermal noise of the receiver.

To ameliorate any potential interference problem, IWG2 recommends that the Commission restrict the occupied bandwidth and tighten the permitted radiation from new microwave ovens.

Therefore, some MSS subscribers may suffer degraded or loss of service in some urban areas.

7.4.3 S-Band PFD Coordination Requirements

MSS/RDSS systems must coordinate with countries on whose territory the PFD exceeds the values specified in RR 2566. To the extent that this PFD limitation is relaxed, it may increase the available channel capacity and/or performance as indicated in Section 5.1.

8.0 ANALYSIS OF THE SHARING OPTIONS

8.1 Maximization of Multiple Entry

Band segmentation of the available spectrum maximizes the opportunity for multiple entry by allowing multiple systems to operate, and by permitting multiple technological approaches to be implemented. In turn, it allows MSS operators with different service objectives to compete in the marketplace.

8.1.1 Accommodation of All Technological Approaches

As described in Section 2 above, the FDMA/TDMA and CDMA proponents have proposed fundamentally different satellite system designs. These different design considerations reflect the different service objectives of the applicants. Thus, different user terminal characteristics reflect different views as to whether the service is intended primarily for handheld, portable, or mobile telephones. Differences in link margins and satellite diversity reflect different views about the degree to which continuous service with a low dropped-call rate is a critical element of the planned service. Differences in coverage and availability reflect different views as to whether service should be continuous or intermittent, and whether it should be global or regional or national. (IWG1-3).

Fundamentally, these differences in satellite system design are a result of different "visions" of the market. (IWG1-34). Motorola's "vision" is "Global PCS" because it believes that customers will want an MSS service that can provide communications to pocket-size terminals that will deliver a high quality signal, capable of reaching users even when their line-of-sight to the satellite is obstructed by buildings, foliage, or other "ground clutter." (IWG1-34-Annex, IWG1-3, MSSAC-15). Due to its high reliability and link margin, Motorola's Iridium system will be able to serve handheld terminals inside motor vehicles and other hard-to-reach places. Motorola also believes its subscribers will want to take their pocket-sized terminals with them wherever they travel in the world and to place, as well as to receive, calls from any location.

Other applicants claim that their proposed CDMA systems will also be able to serve these users, but they concede that, at least initially, they will be able to provide MSS service to handheld users only in certain non-metropolitan areas and will not provide equal robustness of service under difficult propagation conditions. These applicants believe that their market objectives can be met with less than complete and continuous coverage and see no need to offer the level of service described by Motorola.

Some form of band segmentation is necessary to accommodate both technological approaches and visions. All of the parties have concluded that the proposed CDMA systems operating under their interference sharing approach and Motorola's proposed Iridium system cannot operate on the same frequencies over the same areas at the same time and still achieve Motorola's service requirements. Motorola will not proceed with a system that cannot provide the service requirements that it believes the market will demand. (IWG1-3, IWG1-27, IWG1-34, IWG1-57, IWG1-64 and MSSAC-15). The Iridium system modifications proposed by the CDMA applicants, purportedly to make it compatible with full-band interference sharing, would require fundamental changes to the Iridium system design and would prohibit Motorola from achieving its service objectives.

In light of the practical sharing problems posed by the separate visions and technological approaches of the applicants, Motorola proposed the band segmentation sharing plan that is described in Section 2.1. This plan achieves multiple entry by allowing both of the technological approaches that have been proposed to proceed. In turn, it allows the marketplace to determine whether one or both these approaches will succeed. In contrast, the full-band interference sharing plan proposed by the CDMA applicants would not accommodate the Iridium system, and, in effect, would usurp marketplace choices. Adoption of a full band interference sharing plan would essentially eliminate the only system design that contemplates reliable ubiquitous service to hand-held units.

8.1.2 Justification for Segmentation of the Band Into Equal Parts

Motorola's band segmentation proposal has been criticized on the grounds that it gives equal treatment to access techniques rather than to applicants. In fact, this criticism overlooks an important aspect of Motorola's plan. Motorola proposes that the first system would use the entire uplink band and the first two systems (whether both CDMA, or both FDMA, or one of each) would divide the band. Only when a third system becomes operational would the uplink band be divided into two parts on the basis of access technology, and only then if one of the three systems employs a different access technology than the other two (e.g., if there are two CDMA systems and one FDMA system, or vice versa). If no FDMA/TDMA system ever became operational, the CDMA systems would be allowed to operate over the entire spectrum. Thus, under the most likely scenario, in which there will only be one or two operational systems, all operators will, in fact, receive equal amounts of uplink spectrum.

Dividing the 16.5 MHz uplink band equally between technological approaches when the third system becomes operational is reasonable and appropriate for a number of reasons. The allocation of at least 8.25 MHz of uplink spectrum to each modulation approach gives proponents of each vision sufficient bandwidth to begin providing service. The alternatives that have been proposed do not provide each operator sufficient spectrum to pursue its vision. Thus, full band sharing on an interference basis does not permit Motorola's FDMA/TDMA operation at all. Furthermore, dividing the band into 1/N parts, where N represents the number of qualified applicants, and awarding one part to each of the applicants, would not give any applicant enough spectrum for viable operations. For example, assuming six systems, the proposed Iridium system could not operate economically with just 2.75 MHz of spectrum. The result of such a plan would be spectrum warehousing and lotteries.

Moreover, assigning each of the proposed systems an equal amount of spectrum would neither be equitable nor spectrally efficient. At least two of the applicants (Ellipsat and Constellation) envision, at least initially, low capacity systems. Furthermore, as has been demonstrated in Section 5 above, not all systems utilize the spectrum efficiently.

In addition, if each CDMA system is awarded a discrete band segment, the alleged benefits of CDMA sharing would not be automatically realizable. By contrast, dividing the band into two segments, one for CDMA systems and one for FDMA/TDMA systems, permits the CDMA interference sharing approach to operate. Under Motorola's band segmentation plan, CDMA systems would still be able to operate on a co-frequency basis and enjoy whatever capacity gains can be achieved through interference sharing, while FDMA/TDMA systems would also be able to operate as contemplated by their designs.

Dividing the band into two segments of different size that are proportionate to the number of applicants in the current processing round is also inappropriate because the number of current applicants that favor the different technological approaches today is not a reliable indicator of the amount of spectrum that will be needed to accommodate each technological approach in the future. Experience suggests that some of the applicants in the current group may amend their applications or modify their permits to change their basic technological approaches before they launch their systems. Experience further suggests that, at most, only a few of the current group of applicants will ever obtain financing to construct and launch their proposed systems. Thus, the actual number of operational systems using one modulation scheme or the other is likely to be significantly different than is currently proposed. By contrast, dividing the uplink band equally between the two access technologies ensures that the Commission will not prejudge market and technological developments. Instead, the marketplace will be the ultimate judge of competing service and technological approaches.

8.1.3 Justification for Assigning Frequencies to Bi-directional Systems from the Upper End of the L-Band

The Motorola plan contemplates that bi-directional FDMA/TDMA systems would be assigned spectrum in the upper half of the L-band when they become operational. This aspect of the proposal has been criticized on the grounds that it is unfair to assign the lower part of the L-band to CDMA applicants because this part of the band is also occupied by the

Radio Astronomy Service (1610.6-1613.8 MHz) and the Aeronautical Radionavigation Service (1610-1616 MHz) (i.e., Glonass). It is claimed that MSS systems may suffer reduced capacity and/or greater system operational complexity and expense as a result of having to share with these services.

However, bi-directional FDMA/TDMA systems must be assigned spectrum in the upper half of the L-band because secondary downlink operations are only permitted between 1613.8-1626.5 MHz, because the EIRP density limits for the 1610-1616 MHz band are too restrictive for FDMA/TDMA systems, and because keeping bi-directional systems as far as possible from the Radio Astronomy Service will provide Radio Astronomy the maximum possible protection from FDMA/TDMA secondary downlinks. Moreover, if the number of frequencies the Glonass system uses are reduced by one-half, as all the MSS applicants have recommended, MSS operators will eventually be able to use the 1610-1616 MHz band for uplinks without significant constraints.

Assigning spectrum at the top end of the L-band to applicants that propose to operate bi-directionally does not affect any multiple entry objectives or deny spectrum to any primary users. An applicant that is found qualified by the FCC would receive access to the same amount of uplink spectrum under Motorola's plan regardless of whether any bi-directional systems are licensed. The bi-directionality of a given system is relevant only with respect to which frequencies are assigned to operational systems. In fact, CDMA systems would receive access to more spectrum than bi-directional systems under Motorola's band segmentation plan, because they would receive an equal amount of spectrum at S-band.

Some applicants have suggested that as an alternative to allocating the upper half of the L-band to FDMA/TDMA systems, each licensee should be assigned a proportional allotment of spectrum from both the lower and upper portions of the L-band. Aside from the added costs and complexities arising from such a split L-band approach, it would be unacceptable to any bi-directional operator because bi-directional systems need to operate above 1616 MHz in order to avoid interfering with existing users of the band.

8.2 Accommodation of New Systems

Under Motorola's band segmentation plan, multiple FDMA/TDMA and CDMA systems could be accommodated. As a practical matter, however, as long as the 1610-1626.5 and 2483.5-2500 MHz bands remain the only spectrum available for LEO MSS systems, it is likely that there will only be enough spectrum for, at most, two or possibly three "high-capacity" MSS systems, and even then, only for their first generation systems. This is true whether the band is devoted entirely to CDMA systems or band segmented to accommodate both CDMA and FDMA/TDMA systems. Thus, new systems (i.e., other than the ones proposed by the current group of applicants) can only be accommodated in the 1610-1626.5 MHz band if several of the applicants in the current processing group never become operational. Therefore, the Commission should not accept additional applications for MSS service in this band until permits have been granted to qualified applicants in the initial processing group and until after a "shakeout" period to see how many of the current applicants proceed to construct satellites. Additional MSS construction permits for this band should only be granted once it becomes clear that new systems can be accommodated in the bands.

Motorola has long maintained that the amount of spectrum available in the bands under consideration in this proceeding is insufficient to accommodate all of the existing applicants. In this connection, Motorola proposed, at the first meeting of IWG-1, that the work plan of the Committee be expanded to include consideration of two additional bands Motorola had previously identified as viable candidates for MSS LEO systems, including, in particular, the 1675-1710 MHz band, which is currently allocated to the Meteorological-Satellite and Meteorological-Aids Services, and which was allocated to MSS in Region 2 on a co-primary basis at WARC-92. Motorola's proposal to expand the scope of the work plan was rejected by the Committee for procedural reasons and concern about not having sufficient time under the Committee Charter to consider issues not already in the work plan. This action, of course, does not preclude the Commission from considering additional spectrum allocations now or in the near future.

The fact that additional systems might not be accommodated in the limited spectrum currently under consideration does not mean that new MSS systems should not be licensed in the future. All of the current applicants have agreed that competition is desirable. Additional spectrum should be allocated to MSS to accommodate future applicants and to allow for growth of systems licensed to the current group of applicants.

With adequate spectrum, new systems could be licensed under Motorola's band segmentation plan in the same way that the current applicants would be accommodated. In other words, a new system, when it becomes operational, would be licensed either in the CDMA interference sharing sub-band or the dynamic FDMA/TDMA sharing sub-band, depending on the type of access technique it employs.

Moreover, under Motorola's band segmentation plan, it is possible that a portion of the S-band could go unused (because of the Iridium system's bi-directional operations or because 6 MHz of uplink spectrum is being used by Glonass). This spectrum, however, could be assigned to a future bi-directional system. Of course, it could also be used by CDMA applicants to spread their downlinks further, to accommodate displaced S-band fixed service operators, or for other purposes.

8.3 Permitting System Growth

The ability to provide for long term system growth under any sharing plan will, as in the case of accommodating new systems, ultimately depend on finding additional spectrum. In the short term, or at least insofar as first generation systems are concerned, Motorola's band segmentation plan would permit some system growth. CDMA systems would grow the same way that they propose to do under full band interference sharing, except that they would be growing within an 8.25 MHz, rather than 16.5 MHz, uplink band segment. An FDMA/TDMA system, such as Iridium, would be able to grow incrementally into the spectrum allocated to its technology in the same manner. As customer demand increases, the channels in the FDMA/TDMA sub-band would be used more frequently and for increasing amounts of time. If more than one FDMA/TDMA system became operational, the systems would periodically gain or lose spectrum in relation to its overall billed minutes of use, thereby ensuring that the fastest growing system, in terms of customer demand, would receive sufficient spectrum in which to operate, and avoiding spectrum warehousing. Obviously, as demand increases, there will be a point at which no new channels, whether CDMA or FDMA/TDMA, could be added without degrading service.

It is important to recognize that FDMA/TDMA systems may need the full amount of spectrum they have been assigned from the inception of their service in order to satisfy peak demand in a given area. The Iridium system, for example, is designed so that the full amount of spectrum assigned to the system can be concentrated in a given beam in order to provide peak capacity at any given location.

8.4 Avoidance of Mutual Exclusivity

The Committee's Work Program (MSSAC-4), in part, tasked IWG-1 to recommend rules that will "avoid or resolve mutual exclusivity . . . while maintaining the economic viability of the systems." Motorola's proposed band segmentation plan permits the award of construction permits to all qualified applicants, thereby avoiding mutual exclusivity among the applicants.

In addition, Motorola's band segmentation plan should be able to accommodate all authorized licensees in a manner that avoids mutual exclusivity. This is because only operational systems would actually receive authority to operate in the allocated spectrum, and the spectrum would only be sub-divided between technological approaches if both types of systems become operational. Under the Motorola plan, if a permittee fails to operate its satellite system, it will be because that applicant could not succeed in the capital or consumer market, not because the Commission denied it the opportunity to succeed with its technological approach.

As noted above, the amount of spectrum available in the bands under consideration is not expected to be sufficient to accommodate all of the applicants' proposed systems in a manner that would allow all systems to be economically viable. However, Motorola's band segmentation proposal, by awarding spectrum only to systems that actually construct, launch, and operate, takes advantage of the fact that not all systems are likely to survive to the point of operation and makes it likely that the systems that do become operational will have enough spectrum for their first-generation systems.

In this regard, it is customary for the Commission to adopt threshold qualification standards and to impose stringent construction, launch and operating milestones in the satellite area. Given the limited amount of spectrum currently available and given the important technological and economic benefits likely to flow from the successful initiation of MSS service, it is particularly important for the Commission to establish strict legal, financial and technical qualification requirements in this case, and to impose and rigorously apply applicable milestones on permittees.

Only qualified applicants should be authorized to construct their proposed systems. Such requirements could eliminate those applicants without the resources to proceed promptly with their proposed systems, thereby enhancing the likelihood that the remaining permittees will have sufficient spectrum for economically viable systems.

8.5 Limited Domestic Coordination

Under Motorola's band segmentation plan, a procedure would be established to coordinate periodically and adjust access to the available spectrum in both the FDMA/TDMA and CDMA band segments. Such coordination should be administered by the MSS system operators themselves. As explained in Section 2.1, in the case of FDMA/TDMA systems, adjustment of available spectrum under dynamic sharing could be based on the relative number of billed minutes of use for each FDMA/TDMA system. If the grant of each license were to be conditioned on such a procedure, then initial spectrum assignments could be altered as appropriate to reflect the actual service being provided by each system. This also would help assure that maximum use would be made of the spectrum. Dynamic sharing can be accomplished among the systems, without direct Commission involvement, because the basis for adjustment -- billed minutes of use -- is an objective measure and can easily be determined. On the CDMA side, access to the available spectrum would be coordinated pursuant to the interference sharing rules that the CDMA applicants have proposed.

8.6 International Coordination Considerations

International coordination of MSS/RDSS systems under a band segmentation plan will be governed by the same processes and regulations as any other band sharing approach in the subject frequency bands. The regulations and processes are contained in the Radio Regulations of the ITU and the pertinent Resolutions adopted at the 1992 WARC. (IWG1-48).

It is important to note that the coordination process is independent of the modulation technique(s) of the system(s) to be coordinated. The principal consideration is that new systems be accommodated without disrupting existing and planned systems operating in accordance with the international allocations.

All proposed non-geostationary satellite systems are subject to notification and coordination in accordance with the WARC-92 allocation decisions and attendant allocation footnotes. In particular, the process of coordinating the MSS L-band frequencies for non-geostationary MSS systems was established in WARC-92 Resolution 46 (Com 5/8) and is to be applied consistent with the rules of procedures in IFRB Circular Letter No. 921. This procedure is, in most respects, similar to the existing procedure for coordinating satellite systems under the provisions of Article 11. The main difference is that there is no exclusionary test in Resolution 46 such as that provided by the Delta T/T of Appendix 29, called for in Section 2 of Article 11 for geostationary systems. (MSS feederlinks and intersatellite links will be coordinated in accordance with Article 11.)

The basic coordination process is well known and involves the customary steps of Advance Publication, Coordination, and Registration with specific time increments indicated for each stage or step. Of particular interest are the considerations involved in the international coordination phase. This phase provides for coordination of specific satellite system characteristics through the information contained in the publication of the MSS characteristics provided in accordance with Appendix 3 requirements. Under the Resolution procedure, the IFRB publishes the Appendix 3 information with the names of co-frequency Administrations. Administrations decide within six months if coordination is required. The coordination process is conducted on a bilateral basis with all Administrations responding to the publication of Appendix 3 information. Responding Administrations may, in general, seek to protect existing or planned systems registered, or systems that may affect or be affected by the proposed mobile satellite system. The systems of other Administrations may be any that operate or will operate in accordance with the ITU Table of Allocations and other pertinent Radio Regulations. The coordination process may involve negotiations, particularly where there are operating systems.

This ITU coordination process, however, does not encompass domestic coordination of systems within the same Administration. Such coordination between both intra- and inter-service systems is considered to be a domestic issue of a given Administration.

8.6.1 MSS Coordination

Historically, international coordination of satellite systems has involved FDMA and FDMA/TDMA geostationary satellite systems and the process of coordinating systems employing such modulation techniques is well-understood. One important aspect of FDMA and FDMA/TDMA geostationary systems that has facilitated this process is that FDMA-based systems are both frequency and bandwidth agile. (IWG1-48). FDMA non-geostationary satellite systems will be similarly agile. They also have a possible additional, beneficial characteristic. Because the satellites are in motion around the globe and not geostationary, some interference conditions may be transitory.

Coordination of non-geostationary band sharing CDMA systems is expected to be more difficult to achieve since all CDMA transmissions cover the entire sub-band assigned to such systems. For the same reasons that the Iridium system cannot share spectrum with other CDMA systems, foreign FDMA/TDMA systems with the same service objectives as the Iridium system would no be able to share co-coverage, co-frequency with CDMA systems. Foreign co-frequency, co-coverage CDMA MSS systems would have to conform to the same interference sharing rules that U.S.

domestic CDMA systems have accepted in order to avoid serious losses in capacities to all such systems.

Coordination between domestic and international FDMA/TDMA MSS systems would not require co-frequency compatibility. Such systems could be coordinated on a conventional frequency separation basis and, as required, on a geographic separation basis. In contrast, there are no internationally recognized technical bases for determining acceptable interference levels in coordinating co-frequency, co-coverage CDMA-based MSS systems with respect to either individual system or cumulative systems. In this connection, there is no past experience involving coordination of CDMA GSO systems and no established criteria for coordinating CDMA MSS systems with terrestrial systems in other radio services operating in the subject bands.

8.6.2 International Coordination Based on Band Segmentation

Motorola contemplates that its band segmentation plan would be used to assign spectrum in the U.S. It does not propose that band segmentation necessarily be extended to other parts of the world. Use of the band elsewhere in the world would be determined by international coordination of U.S. systems with other systems providing MSS service. However, as a starting point, coordination of a foreign system with any specific U.S. MSS LEO system could be based on grouping it with the appropriate technological approach (CDMA or FDMA/TDMA) of any existing or planned compatible MSS system.

In this connection, it is likely that U.S. systems will need to coordinate with foreign MSS systems. In fact, Inmarsat has already provided the IFRB with Appendix 3 information concerning Inmarsat-4 LEO/GEO networks. Two of these networks propose to use the 1616.0-1626.5 MHz and the 2483.5-2500.0 MHz bands employing either FDMA/CDMA or FDMA/TDMA modulation.

8.7 Ease of Administration

The CDMA proponents assert that feasibility of administration should be one of the criteria used to evaluate band segmentation options. While some band segmentation plans may require the FCC to decide which applicant gets which band segment, such as band segmentation by number of applicants or by channelization, this is not true of the plan-which Motorola has proposed.

From an administrative standpoint, Motorola's band segmentation plan is self-implementing; that is, once a system is authorized to operate in either the CDMA half or the FDMA/TDMA half of the band, the specific frequencies on which it would operate are determined in advance. For example, assuming that at least one CDMA and one FDMA/TDMA system become operational, the FDMA/TDMA system would automatically be authorized to operate in the upper half of the L-band and the CDMA system in the lower half. The specific frequencies assigned to the FDMA/TDMA system would be governed by whether it is a bi-directional system and/or when it becomes operational. The amount of spectrum assigned to a given FDMA/TDMA system within its sub-band initally would be coordinated between the system operators and later governed by the dynamic sharing formula. CDMA systems would operate across all frequencies in the lower band segment through interference sharing as they have proposed.

If an operational FDMA/TDMA system fails, the remaining FDMA/TDMA system(s) would eventually occupy the spectrum vacated by the failed system. If an operational CDMA system fails, the remaining CDMA system(s) would continue to operate over the same band segment. If at any point there is only one operational system, regardless of access technique, it would occupy all available bandwidth, or as much thereof as it needs. Further, the Commission is always able to consider authorizing additional licensees as circumstances and interest warrant. Thus, no spectrum in the band need ever lie fallow so long as one MSS system remains operational. If the only operational system were a bi-directional system, the 1610-1616 MHz band would not be used by such a system, but would continue to be used by other services. In addition, the paired spectrum at S-band would not be lying fallow in that instance because it is already being used by other fixed services.

Finally, as noted in Section 2.1, disputes involving adjustment of band segments on the FDMA/TDMA side are unlikely given the objective and easily discernable measure of reallocating spectrum on the basis of billed minutes of use. Should a dispute arise, however, it could be resolved in accordance with procedures established in advance by the FDMA/TDMA licensees. For example, an independent arbitrator could be used. Thus, at least insofar as FDMA/TDMA dynamic sharing is concerned, the Motorola plan would not impose a significant burden on, or directly involve, the Commission in the day-to-day administration or resolution of disputes. It is unclear whether CDMA licensees would likewise employ an independent arbitrator to resolve disputes because disputes among CDMA systems will involve the allocation of interference, which, as a technical issue, falls squarely within the Commission's jurisdiction.

9.0 TECHNICAL RULES AND RECOMMENDATIONS

9.1 Technical Rules

9.1.1 Replace subsection (25) to Section 25.114(c) with the following:

(25) Applications for authorizations in the Mobile and Radiodetermination Satellite Service in the 1610-1626.5 MHz and 2483.5-2500 MHz bands shall also provide all information specified in §25.141.

9.1.2 Amend Section 25.141 of the Commission's Rules to read as follows:

§ 25.141. Licensing Provisions For The Mobile and Radiodetermination Satellite Service in the 1610-1626.5 MHz and 2483.5-2500 MHz Bands.

(a) Space station application requirements. Each application for a space station license in the Mobile and Radiodetermination Satellite Service in the 1610-1626.5 MHz and/or 2483.5-2500 MHz bands shall describe in detail the proposed Mobile and Radiodetermination Satellite Service satellite system, setting forth all pertinent technical and operational aspects of the system, including its capability for providing radiodetermination service on a geographic basis, and the technical, legal and financial qualifications of the applicant. In particular, each applicant shall include the information specified in Section 25.114, except that applicants for non-geostationary Mobile and Radiodetermination Satellite Service systems, in lieu of providing the information concerning orbital locations requested in Section 25.114(c)(6), shall specify the number of space stations that will comprise its system and their orbital configuration, including the number of planes and their inclinations, altitude(s), argument(s) of perigee, service arc(s), and right ascension of ascending node(s). Applicants must also file information demonstrating compliance with all requirements of this section.

(b) User transceivers. Individual user transceivers will not be licensed. Service vendors may file blanket applications for transceiver units using FCC Form 493 and specifying the number of units to be covered by the blanket license. FCC Form 430 should be submitted if not already on file in conjunction with other facilities licensed under this subpart. Each application must show that its user transceiver units will comply with the technical parameters of the satellite system(s) with which the units will communicate.

(c) Permissible communications. Stations in these bands are authorized to render both mobile satellite and radiodetermination satellite communications services.

(d) Frequency assignment policies.

(1) Definitions.

(i) "Operational system." A system shall be considered "operational" for the purposes of this section when it begins providing commercial services.

(ii) "Access technique." For the purposes of this section, the term "access technique" includes FDMA/TDMA and CDMA modulations.

(2) Each satellite system authorized under this section shall be issued a construction permit for the entire allocated frequency bands, unless otherwise specified therein.

(3) The first licensee to launch an operational system shall be entitled to use the entire bandwidth specified in its license, subject to the conditions set forth in this section.

(4) If two systems become operational and both employ the same access technique, the two systems shall coordinate use of the 1610-1626.5 MHz band with each other as

follows:

(i) If both are FDMA/TDMA systems, the two systems shall share the band through dynamic sharing, as set forth in subsection (e)(8).

(ii) If both are CDMA systems, the two systems shall share the band through interference sharing, as set forth in subsection (e)(9).

(5) If two or more systems become operational and employ different access techniques, the entire band shall be partitioned into two equal sections as follows:

(i) The FDMA/TDMA systems shall operate in the 1618.25-1626.5 MHz portion of the band.

(ii) The CDMA systems shall operate in the 1610-1618.25 MHz portion of the band.

(6) If three or more systems become operational and all systems employ the same access technique, they shall coordinate use of the entire band as follows:

(i) If all are FDMA/TDMA systems, they shall share the band through dynamic sharing, as set forth in subsection (e)(8).

(ii) If all are CDMA systems, they shall share the band through interference sharing, as set forth in subsection (e)(9).

(7) If three or more systems become operational and at least one employs a different access technique than the others, the entire band would be partitioned into two equal sections as follows.

(i) FDMA/TDMA systems shall share the 1618.25-1626.5 MHz portion of the band through dynamic sharing, as set forth in subsection (e)(8).

(ii) CDMA systems shall share the 1610-1618.25 MHz portion of the band through interference sharing, as set forth in subsection (e)(9).

(8) Dynamic sharing. The FDMA/TDMA segment of the band shall be partitioned among the FDMA/TDMA systems in accordance with this section.

(i) Initial spectrum assignments shall be coordinated between FDMA/TDMA licensees with an understanding that new entrants will receive sufficient spectrum to begin operation.

(ii) Every three months after both systems become operational, the amount of spectrum assigned to each system shall be adjusted on the basis of each systems' originating and terminating billed minutes of use in the United States in accordance with the following formula:

$$\text{Allocated Bandwidth Per System} = \frac{\text{Billed Minutes of Use Per System}}{\text{Sum of All Billed Minutes of Use for All Systems}} \times \text{Total FDMA/TDMA Bandwidth (MHz) Available}$$

(iii) The specific band segments assigned to each FDMA/TDMA system shall be based on the following:

(A) Bi-directional systems shall be assigned spectrum in the 1616-1626.5 MHz portion of the band only and shall be assigned spectrum from the upper end of the band.

(B) Uni-directional systems shall be assigned spectrum from the lower end of the band up.

(C) Between multiple bi-directional systems or between multiple uni-directional systems, spectrum assignments shall be made in accordance with the order in which systems become operational, with higher frequencies being assigned before lower frequencies.

(9) Interference sharing. CDMA systems shall operate in their segment of the band on a non-exclusive basis. Coordination procedures and power limits as set forth below shall be employed to avoid harmful interference with other CDMA systems in the CDMA band segment.

(i) CDMA licensees shall coordinate with other CDMA licensees to avoid mutual harmful interference. During the coordination processes, CDMA licensees shall exchange relevant information and interference calculations, subject to appropriate confidentiality arrangements, and shall meet as necessary to negotiate in good faith to resolve potential interference problems. Coordination hereunder shall be a continuous process, taking into account changes in system parameters, traffic configuration, and other relevant factors. Existing CDMA licensees shall coordinate with new CDMA licensees as authorized by the Commission, and in the absence of agreement, the Default Values specified in the Commission's Report and Order in CC Docket [xx-xx] shall apply.

(ii) Technical coordination in the CDMA band segments is based on the equitable allocation of interference noise among systems sharing these bands. A non-CDMA system shall not cause a higher level of interference to a CDMA system, nor place any more restrictive constraints on the operations of a CDMA system, than that imposed by any other single CDMA system operating in the CDMA band segments.

(iii) Coordination agreements would typically be based on mutually agreed values of the following parameters of each system operating in the band:

(A) The maximum value of the downlink PFD at any point in the service area per system, averaged over an appropriate period of time. Polarization effects shall be considered when calculating the maximum PFD.

(B) The maximum aggregate EIRP density simultaneously radiated by all user terminals for a single system within the Continental United States averaged over an appropriate period of time.

(C) Polarization;

(D) Frequency plans;

(E) Code structures and associated cross correlation properties;

(F) Antenna beam patterns; and

(G) Signal burst structures.

(iv) In the absence of mutual agreement during the coordination process referenced above, the operations of CDMA satellite systems licensed under this section will be limited to the default values of maximum downlink PFD spectral density